

## **REMARKS**

Responsive to the objections and rejections made of the Examiner in office action. We have amended the specification, claims and abstracts. All the errors disclosed in that office action has been corrected according to the Examiner's indications disclosed in the official action.

Since in the office action, the original claims 7, 8 and 10 are allowed, thus in this amendment, the applicant decides to cancel Claims 1 to 6, 9, 11 to 17 (11 to 17 are original cancelled in the previous amendment), without prejudice or disclaimer of the subject matter thereof, add amend claims 7, 8, and 10 as the following. Claim 7 is the combination of the original claims 1, 4 and 7 (since the claim 7 is dependent to claim 4 and the claim 4 is dependent to claim 1), claim 8 is the combination of the original claims 1, 4 and 8 and the claim 10 is the combination of the original claims 1, 4 and 10. In the amendment of the claims, the screwing angle is changed as screw angle and some minor errors are amended. Thereby it is assured that no new matter is added in this amendment.

We feel sorry in the numerals of the elements of the present invention in the specification, claims, and drawings so that make the reader feel fuzzy, this is because in the original scripts are modified many times. In the amendment, we have carefully checked and amend the numerals of elements about the thread section, helix angle, thread and pitch for all the specification, drawings, abstract and claims. After amendment, all these are matched. According to instruction of Examiner in the office action, we have re-number elements.

**If there still is any error in the claims or specification, Applicant requests and authorizes Examiner to amend the claims of the present invention so that the claim and specification can match the requirement of U. S. Patent. Attentions of Examiner to this matter**

**are greatly appreciated.**

Since in the original claims 7, 8 and 10 are allowed, and in this amendment, the applicant has cancelled Claims 1 to 6, 9, 11 to 17, and we have amended the specification, claims and abstracts. All the errors disclosed in that office action has been corrected according to the Examiner's indications disclosed in the official action. Thus, it is now believed that the subject Patent Application has been placed in condition for allowance, and such action is respectfully requested.

Respectfully submitted.

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Dated: 05 / 28 /2005

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## **“MARK-UP” COPY OF THE AMENDED SPECIFICATION**

### **SCREW WITH A PLURALITY OF HELIX ANGLES AND MOLD DEVICE FOR FORMING THE SAME**

#### **Field of the invention**

The present invention relates to screws, and particular to a screw with a plurality of helix angles and a mold device for forming the screw.

#### **Background of the invention**

The prior art screw has a thread with unique orientation. With reference to Fig. 12, an operation for ~~about~~ screwing a prior art screw is illustrated. It is illustrated that the screw is screwed into a work piece with a constant orientation. This results in that ~~It results that~~ the screw is tightly clamped by the work piece so that the friction force is larger and thus the screwing work is difficult. When the screw is longer, the difficulty in locking the screw is enhanced.

#### **Summary of the invention**

Accordingly, the primary object of the present invention is to provide a screw with a plurality of helix angles which comprises a first section having a first thread with a first helix angle, at least one third section having a third ~~second~~ thread with a third ~~second~~ screwing angle; and a fifth section having a first thread with a first helix angle. The third ~~second~~ helix angle is equal or not equal to the first helix angle. Moreover, screw further comprises a second section connected between the first section and the third section; the second section having a second ~~fourth~~ thread with a second ~~fourth~~ helix angle; a fourth section connected

between the third section and the fifth section; and the fourth section having a fourth ~~third~~ thread with a fourth ~~third~~ helix angle. A mold device for forming the screw is also included.

The various objects and advantages of the present invention will be more readily understood from the following detailed description when read in conjunction with the appended drawing.

### **Brief Description of the Drawings**

Fig. 1 is a plan schematic view of the screw of the present invention.

Fig. 2 is a schematic view showing that the first helix angle is greater ~~larger~~ than the second helix angle according to the present invention.

Fig. 3 is a schematic view showing that the first helix angle is smaller than the second helix angle according to the present invention.

Fig. 4 is a cross section view showing that a screw is screwed into a work piece according to the present invention.

Fig. 5 is a schematic view showing the curves in the twisting test according to the present invention.

Fig. 6 is a schematic perspective view of the mold device of the present invention.

Fig. 7 is a plan schematic view of the mold device of the present invention.

Fig. 8 is a schematic perspective view of a two mold case of the present invention.

Fig. 9 is a schematic view showing that the orientation of the first sloped recess is greater ~~larger~~ than that of the second sloped recess according to the present invention.

Fig. 10 is a schematic view showing that the orientation of the first sloped recess is smaller than that of the second sloped recess according to

the present invention.

Fig. 11 is a schematic view showing the curves about the twisting test of the prior art.

Fig. 12 is a schematic cross view about the operation of the prior art screw.

### **Detailed Description of the Invention**

In order that those skilled in the art can further understand the present invention, a description will be described in the following in details. However, these descriptions and the appended drawings are only used to cause those skilled in the art to understand the objects, features, and characteristics of the present invention, but not to be used to confine the scope and spirit of the present invention defined in the appended claims.

The present invention will be described here.

With reference to Figs. 1 to 3, the screw 1 of the present invention includes a first section 51 having a first thread 11 with a first helix angle  $\theta_1$ , and at least one third section 53 having a third ~~second~~ thread 13 ~~12~~ with a ~~second~~ third helix angle  $\theta_3$   ~~$\theta_2$~~  and a fifth section 55 having a fifth thread 15 with the first helix angle  $\theta_1$  which is ~~the~~ identical to that in the first section 1. Indeed, the fifth thread 15 is identical the first thread 11, namely, they have the same thread pitch and helix angle. The third ~~second~~ helix angle  $\theta_3$   ~~$\theta_2$~~  is not equal to the first helix angle  $\theta_1$ . Preferably, the third ~~second~~ helix angle  $\theta_3$   ~~$\theta_2$~~  is greater ~~larger~~ than the first helix angle  $\theta_1$  or the third ~~second~~ helix angle  $\theta_3$   ~~$\theta_2$~~  is smaller than the first helix angle  $\theta_1$ .

A second section 52 is connected between the first section 51 and the third section 53. The second section 52 has a second ~~fourth~~ thread 12 ~~14~~ with a second ~~fourth~~ helix angle  $\theta_2$   ~~$\theta_4$~~ . A fourth section 54 is connected between the third section 53 and the fifth section 55. The fourth section

54 has a fourth ~~third~~ thread 14 ~~13~~ with a fourth ~~third~~ helix angle 04 ~~03~~. The fourth ~~third~~ helix angle 04 ~~03~~ is smaller than the first helix angle 01 and / or the second ~~fourth~~ helix angle 02 ~~04~~ is smaller than the first helix angle 01.

The thread pitch of the third ~~second~~ thread 13 ~~12~~ is 150 to 170 % of the thread pitch of the first thread 11, and the thread pitch of the fourth ~~third~~ thread 14 ~~13~~ and / or the second ~~fourth~~ helix angle 02 ~~04~~ is 67 to 75 % of that of the first thread 11.

The thread pitch of the third ~~second~~ thread 13 ~~12~~ is 30 to 50 % of the first thread 11; and the thread pitch of the fourth ~~third~~ thread 14 ~~13~~ and / or second ~~fourth~~ thread 12 ~~14~~ is 125 to 135 % of that of the first thread 11.

The fourth ~~third~~ helix angle 04 ~~03~~ is equal or unequal to the second ~~fourth~~ helix angle 02 ~~04~~.

Referring to Figs. 4, the operation of the present invention will be described here. In screwing the screw 1, the fifth section 55 firstly moves into the work piece, and the fifth thread 15 identical to the first thread 11 serves to cut into the work piece, where the indication A in Fig. 4 is a cut screw channel. When the fourth section 54 having the fourth ~~third~~ thread 14 ~~13~~ enters into the work piece, the channel A will be enlarged at one side so as to be form with an enlarged portion A1 due to the fourth ~~third~~ helix angle 04 ~~03~~ of the third thread 13 fourth ~~third~~ thread 14 ~~13~~ different from the first helix angle 01 as the dashed line shown in Fig. 4. When the screw 1 enters into the work piece continuously, due to the third ~~second~~ helix angle 03 ~~02~~ of the third ~~second~~ thread 13 ~~12~~, the channel A is further enlarged at another side so as to be formed with ~~form~~ another enlarged portion A2. Next, the second ~~fourth~~ thread 12 ~~14~~ enters into the work piece. The channel is further enlarged to have a proper width as the indication A2 shown in Fig. 4. Thereby, when the first section 51 of the screw with the first thread 11 further enters into the

work piece, since the channel is enlarged, the screw can enter into the work piece with less friction. This is especially beneficial for long screws.

The test result of the present invention with the prior art screw will be described herein.

The test object: CHIB wood screw.

Specification: Major diameter / depth of the thread / pitch : 4.0 / 50 / 1.8

Number of test object: 10, the average value is calculated.

Referring to Figs. 5, the test result is illustrated. It is illustrated the larger twisting force of the screw of the present invention is at a point of about 2.0 to 2.5 cm with an average twisting force of 34.2 kg/cm. Then, after the portion of the screw after that point, the twisting force is normal. This means that when a long screw is used, less power is necessary. The required twisting force will not increase due to the increment of length of the screw.

Referring to Figs. 11, it is illustrated that the average value for the prior art screw is 46.1 /kg/cm. The longer the screw, the larger the twisting force. Thus it is difficult to lock a long screw.

Thereby, it is known from above test result, as comparing with a screw of 5 cm, the present invention can save a force of 25 % than the prior art. The longer the screw, the greater ~~larger~~ the force to be saved.

With reference to Figs. 6 to 10, the mold for forming the screw 1 of the present invention will be described herein. A mold 2 for forming a screw with a plurality of screw angle comprises a first mold which has a plurality of recesses 61 (see Fig. 8) approximately arranged in parallel. Each recess 61 includes two first sloped recesses 21 for forming the first thread 11 with a first helix angle  $\theta_1$  and a second sloped recess 22 for forming the second thread 12 with a second helix angle  $\theta_2$ . The second

sloped recess 22 is connected between the two first sloped recesses 21. The orientation of the second sloped recess 22 is different from that of the first sloped recesses 21.

With reference to Figs. 7, 9, and 10, the first mold further includes a third sloped recess 23 connected between one of the first sloped recess 21 and the second sloped recess 22 so as to be as an input end and a fourth sloped trench 24 connected between the other one of the first sloped recess 21 and the second sloped recess 22 so as to be as an output end.

The orientations of the third sloped recess 23 and the fourth sloped trench 24 may be identical or different. Preferably, when the orientation of the first sloped recess 21 is set as a horizontal direction, the absolute value of the slope of the third sloped recess 23 is identical to or different from the slope of the fourth sloped trench 24.

In the present invention, the slope of the orientation of the second sloped recess 22 is larger than that of the first sloped recess 21, as shown in Fig. 9 or the slope of the orientation of the second sloped recess 22 is smaller than that of the first sloped recess 21, as shown in Fig. 10.

Moreover, the mold 2 further comprises a second mold 201. The second mold is symmetrical to the first mold, as shown in Fig. 8.

The present invention is thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the present invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

## ABSTRACT

The screw with a plurality of helix angles comprises a first section having a first thread with a first helix angle, at least one third section having a third ~~second~~ thread with a third ~~second~~ helix angle; and a fifth section having a fifth thread with the first helix angle wherein the fifth thread is identical to the first thread. The third ~~second~~ helix angle is equal or not equal to the first helix angle. Moreover, the screw further comprises a second section connected between the first section and the third section; the second section having a second ~~fourth~~ thread with a second ~~fourth~~ helix angle; a fourth section connected between the third section and the fifth section; and the fourth section having a fourth ~~third~~ thread with a fourth ~~third~~ helix angle. A mold device for forming the screw is also included. The mold device further comprises a second mold line-symmetrical to the first mold.

### IN THE DRAWING

Please amend the drawings 1 to 3 and 11 to 12 as the following. The amendment of the drawings is based on the suggestion of Examiner in the office action. The elements are re-numbered and Figs. 11 and 12 are added the description of prior art. No other portion is amended. Thereby, no new matter is added.



# Annotated Marked-up Drawings

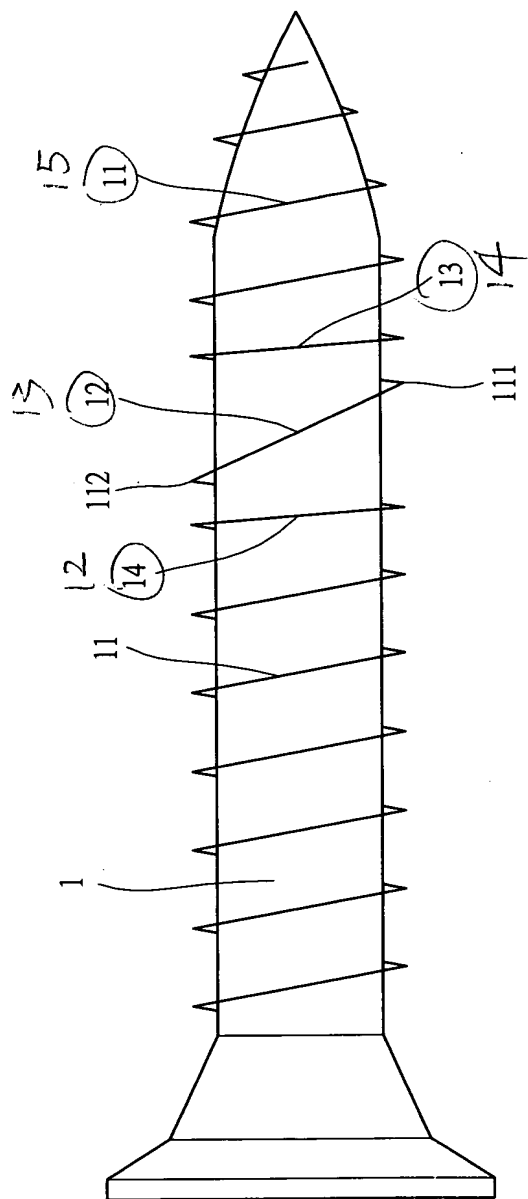


Fig. 1

Annotated Marked-up Drawings

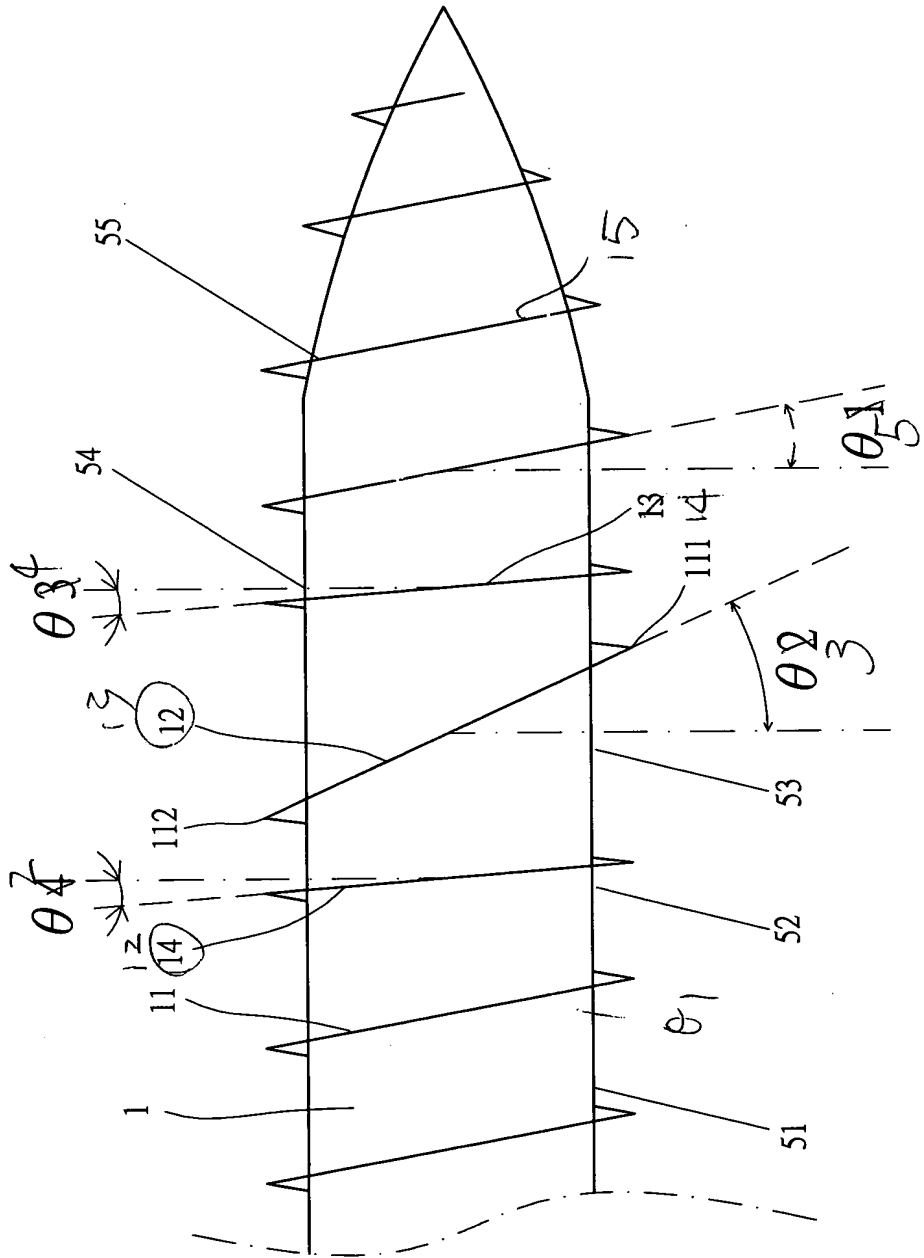


Fig. 2

# Annotated Marked-up Drawings

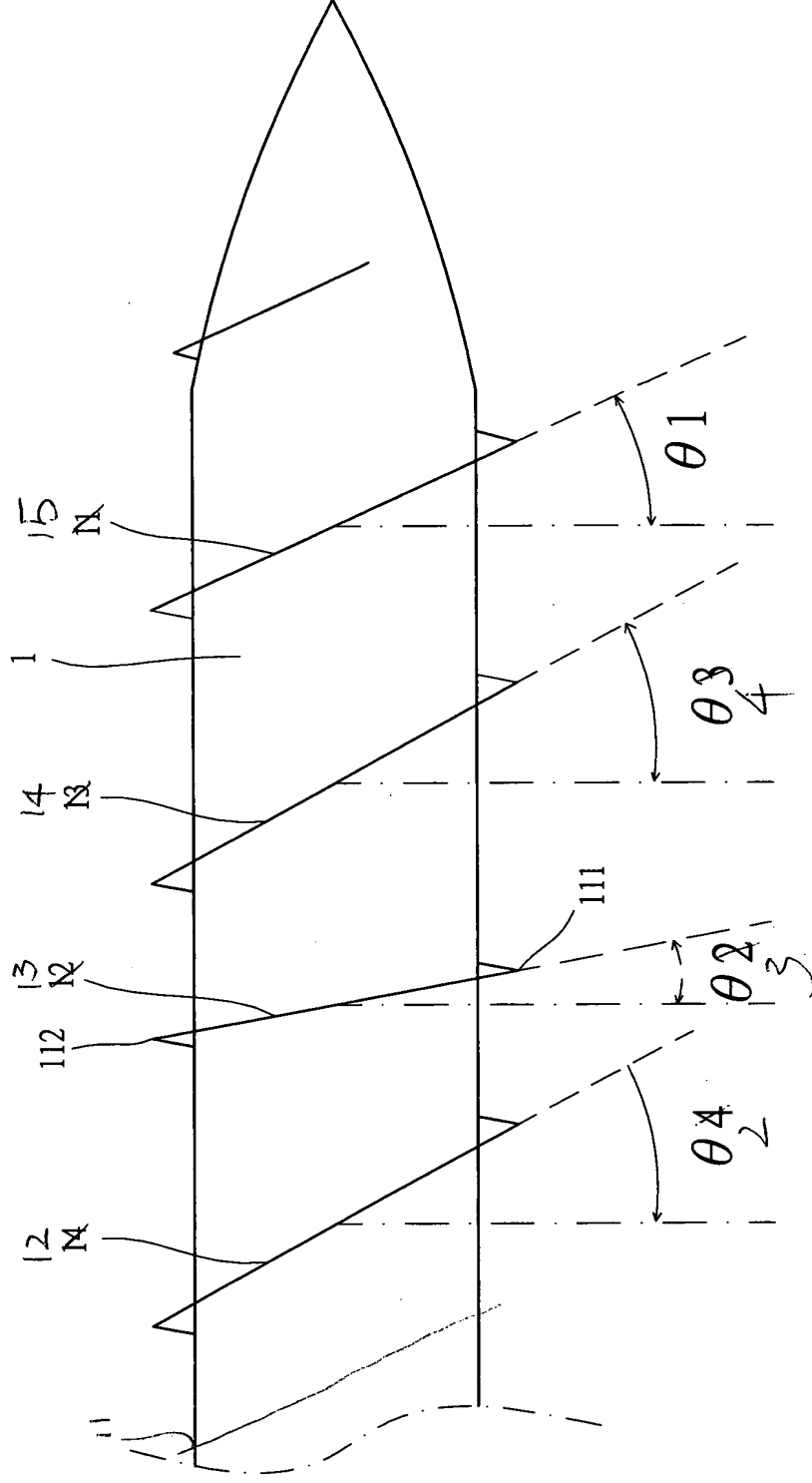


Fig. 3

## Annotated Marked-up Drawings

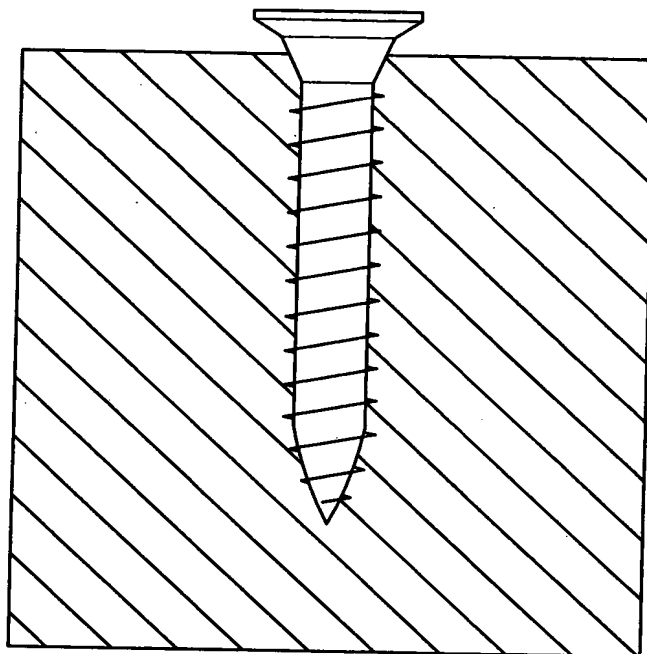


Fig. 12

## Annotated Marked-up Drawings

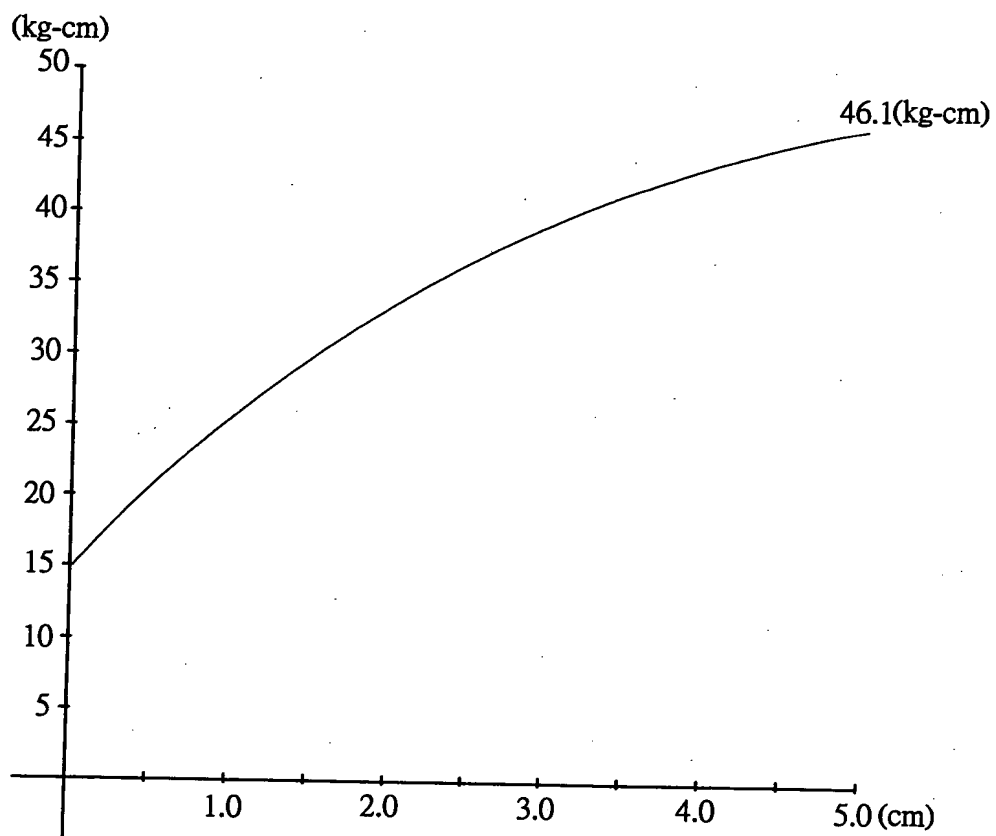


Fig. 11